American POTATO JOURNAL

Volume 31 *February 1954* *Number 2*

CONTENTS

Comparison of Polyethylene with Various Other 10-pound Consumer Bags for Sebago, Katahdin and Green Mountain Potatoes—*Robert E. Hardenburg* 29

Red La Soda — A Mutation of La Soda—*R. E. Webb and Julian C. Miller* 40

Sunken Scald Spot Field Injury Evident in Stored Potatoes —*T. M. Whiteman and J. M. Lutz* 43

Book Review — The Cytology and Genetics of the Potato *(Solanum tuberosum)* and Related Species, by M. S. Swaminathan and H. W. Howard—*F. J. Stevenson* 50

Potato Association Committees 51

Financial Statement 52

Official Organ of

THE POTATO ASSOCIATION OF AMERICA

NEW BRUNSWICK, NEW JERSEY

INCREASE YIELD AND QUALITY WITH FERTILIZER

CONTAINING SOLUBLE MAGNESIUM—THE FOURTH PLANT FOOD ELEMENT

Sul-Po-Mag®

WATER-SOLUBLE $K_2SO_4 \cdot 2MgSO_4$
DOUBLE SULFATE OF POTASH-MAGNESIA

Sul-Po-Mag supplies a properly balanced combination of sulfate of potash and sulfate of magnesium, both in soluble form. Leading fertilizer manufacturers regularly use *Sul-Po-Mag* in their quality grades to provide soluble magnesium. Look for it *in* the bag and *on* the bag.

potash division

INTERNATIONAL MINERALS & CHEMICAL CORPORATION
General Offices: 20 North Wacker Drive, Chicago 6

When You Buy

Minnesota CERTIFIED Seed Potatoes

You are investing in a commodity produced by a group of growers who understand and know how to meet the many problems involved in growing

HIGH QUALITY SEED STOCK

Certified Seed List sent on request

STATE OF MINNESOTA
DEPARTMENT OF AGRICULTURE

SEED POTATO INSPECTION AND CERTIFICATION

St. Paul Campus **University of Minnesota**

St. Paul 1, Minnesota

The Cost per Bushel

The efficient use of fertilizer to lower unit cost of production is sound economics for the farmer at any time. It becomes doubly important in a situation of declining farm prices. To assure good profit per bushel on the potatoes you raise this year, be sure they have available sufficient plant food, particularly potash, to make high yields of top quality. Potatoes are greedy feeders on potash. To grow a good crop of No. 1's, soil and fertilizer must supply at least 200 lbs. of available potash (actual K_2O per acre.)

American Potash Institute, Inc.

1102 Sixteenth St., N.W. Washington 6, D.C.

Member Companies:

American Potash & Chemical Corporation • Duval Sulphur & Potash Company • Potash Company of America • Southwest Potash Corporation • United States Potash Company

PRINCE EDWARD ISLAND

Specializing In High Class

SEED POTATOES

FOUNDATION AND CERTIFIED

IRISH COBBLER — GREEN MOUNTAIN — SEBAGO
KATAHDIN — PONTIAC

— Write for Free Booklet and Quotations -

P. E. I. POTATO MARKETING BOARD

Charlottetown, P. E. I. Canada

Potato Planting Performance that PAYS . . .

. . . the Fast, Accurate JOHN DEERE 12 PICKER ARM PLANTER (1- AND 2-ROW)

Potato planting season is coming! Will you be equipped to take advantage of the breaks in the weather and get a fast, accurate job of seeding for maximum yields, maximum profits? With the latest-type John Deere 2-Row, shown above, you can plant up to fifteen acres a day with 98 to 100 per cent accuracy! That's real efficiency. The 1-Row will plant up to seven acres per day. Both planters have the famous John Deere 12-arm picker wheel, the secret of the long success these planters have enjoyed.

In addition to speed with accuracy, you get outstanding John Deere light draft, good balance, sturdy construction, and easy servicing. Large-capacity fertilizer attachment places fertilizer accurately in band method . . . any amount you want from 100 pounds per acre up to 3500 pounds per acre.

Look to your spring needs now. Visit your John Deere dealer—have a look at these modern potato planters. Write today to *John Deere, Moline, Illinois, Dept. D61,* for free literature.

JOHN DEERE QUALITY FARM EQUIPMENT

JOHN DEERE, Moline, Illinois

Quality Potato Tools For More Than 60 Years

Maine Shipped — 8000 Cars of Certified Seed Last Season

This Year Maine Again Offers A Quality Crop of

CERTIFIED SEED POTATOES

- High Yielding Strains
- Well Graded
- Uniformly Sized
- Low in Disease Content
- Large Selection of Varieties

Get the Best — Buy Maines

for list of growers write

E. L. Newdick, Chief
Division of Plant Industry
Maine Department of Agriculture
Augusta, Maine

American Potato Journal

PUBLISHED BY
THE POTATO ASSOCIATION OF AMERICA
NEW BRUNSWICK, N. J.

EXECUTIVE COMMITTEE

WM. H. MARTIN, *Editor*
E. S. CLARK, J. C. CAMPBELL, *Associate Editors*
Rutgers University, New Brunswick, N. J.

J. W. SCANNELL, *President* ..... Department of Agriculture, Ottawa, Canada
ARTHUR HAWKINS, *Vice President* ..... University of Connecticut, Storrs, Conn.
R. W. HOUGAS, *Secretary* ..... University of Wisconsin, Madison, Wis.
JOHN C. CAMPBELL, *Treasurer* ..... Rutgers University, New Brunswick, N. J.
J. H. MUNCIE, *Past President* ..... Michigan State College, East Lansing, Mich.
CECIL FRUTCHEY, *Director* ..... Colorado A & M College, Ft. Collins, Colo.
N. M. PARKS, *Director* ..... Department of Agriculture, Ottawa, Canada
PAUL EASTMAN, *Director* ..... Department of Agriculture, Augusta, Maine

Price $4.00 per year in North America
$5.00 in other countries after January 1, 1954

Entered as second class matter at New Brunswick, N. J., March 14, 1942 under Act of March 3, 1879. Accepted for mailing at special rate of postage provided for in section 412, Act of February 28, 1925, authorized on March 14, 1928.

SUSTAINING MEMBERS

H. H. ROBERTSON CO. ..... Pittsburgh, Pennsylvania
THE DOW CHEMICAL CO. ..... Midland, Michigan
STARKS FARMS INC. ..... Route 3, Rhinelander, Wisconsin
BACON BROTHERS ..... 1425 So. Racine Ave., Chicago 8, Illinois
L. L. OLDS SEED CO. ..... Madison, Wisconsin
FRANK L. CLARK, Founder — Clark Seed Farms ..... Richford, New York
RED DOT FOODS, INC. ..... Madison, Wisconsin
INTERNATIONAL HARVESTER CO. ..... Chicago, Illinois
ROHM & HAAS COMPANY ..... Philadelphia, Pennsylvania
CALUMET DIVISION, CALUMET & HECLA, INC. ..... 1 Calumet Ave., Calumet, Michigan
WISE POTATO CHIP CO. ..... Berwick, Pennsylvania
JOHN BEAN DIVISION, FOOD MACHINERY CORP. ..... Lansing 4, Michigan
S. KENNEDY & SONS, Growers and Shippers of Potatoes and Onions ..... Clear Lake, Iowa
MATHIESON CHEMICAL CORP. ..... Mathieson Bldg., Baltimore, 3, Maryland
AMERICAN AGRICULTURAL CHEMICAL CO. ..... Carteret, New Jersey
GREEN CROSS INSECTICIDES ..... Montreal, Ottawa, Canada

We welcome the above firms as sustaining members and express to them our appreciation for their interest and financial support.

COMPARISON OF POLYETHYLENE WITH VARIOUS OTHER 10-POUND CONSUMER BAGS FOR SEBAGO, KATAHDIN, AND GREEN MOUNTAIN POTATOES[1]

ROBERT E. HARDENBURG[2]

Packaging of potatoes in consumer-size bags is now an established practice. A few years ago 15-pound bags were the preferred size. Now 10-pound bags are in greatest demand, but many 5-pound bags also are sold.

Several different types of consumer bags made of kraft paper, cotton or paper mesh, and transparent plastics are now available for packaging potatoes. Lutz, Findlen, and Ramsey (5) recently evaluated several types of 5- and 10-pound bags for Triumph and Pontiac potatoes from the Red River Valley. They reported that amount of greening was in proportion to the visibility which a package permitted. Solid kraft paper bags gave better protection against greening than any other type. Using mesh bags or the newer type transparent bags (polyethylene and Pliofilm), Lutz, Findlen, and Ramsey found that greening generally was not serious until after 3 days' exposure to moderate light, 25 foot-candles for 9 hours per day. Elastic-top polyethylene bags were found to be satisfactory if perforated; if they were not perforated considerable moisture condensed in them and mold and decay developed.

Larsen (4), Folsom (3), and others studied light greening and reported that greening develops faster at room temperatures than in cold storage. Larsen found that increasing the light intensity increased greening but not in direct proportion to the increase. Several marketing studies (1, 2, 7) pointed out the importance of greening of potatoes in retail stores in bulk bins and in open-type bags. However, the present trend is to use more and more packages that allow consumers to see the commodity. Probably this trend will continue even though greening will be a recognized problem.

The purposes of the tests reported here were (1) to determine the effect of different numbers and types of perforations in polyethylene bags on the relative humidity within bags and the keeping quality (weight loss, decay, and surface mold) of potatoes and (2) to compare keeping quality (weight loss, decay and greening) of potatoes grown in the East when pre-packaged in 6 types of 10-pound bags and stored at a 40° and 70° F.[3]

[1]Accepted for publication September 22, 1953.
Report of a study in which certain phases were carried on under the Agricultural Marketing Act (RMA Title II).

[2]Horticulturist, Division of Handling, Transportation, and Storage of Horticultural Crops, Bureau of Plant Industry, Soils, and Agricultural Engineering, Agricultural Research Administration, United States Department of Agriculture, Beltsville, Md.

[3]The cooperation of the following firms in supplying the bags is gratefully acknowledged: Union Bag and Paper Corp., New York, N. Y.; Bemis Bro. Bag Co., Minneapolis, Minn.; Shellmar Products Corp., Mount Vernon, O.; Dobeckmun Co., Cleveland, O.; Western Products Inc., Newark, O.; and Chase Bag Co., Chicago, Ill.

Experiment I (Perforation and Relative Humidity Test)

Description of Perforation and Relative Humidity Test

Ten-pound polyethylene and kraft bags with different numbers of perforations were tested first without potatoes. A pan of water having 15.9 sq. in. of evaporating surface was placed in the bottom of each bag. Each bag was held upright and expanded by a wire-screen frame as shown in figure 1.

In the second part of this test Sebago and Green Mountain potatoes were packaged in the bags without wire frames as shown in figure 2. The Sebago potatoes were freshly harvested from New Jersey, whereas the Green Mountain potatoes from Maine had been stored at 40° F. in Beltsville, Maryland for two weeks prior to the test. Both varieties were washed, after which one-half of each lot was allowed to dry before packaging and one-half was packaged when still damp. Wire "Twist-ems" were used to close the polyethylene bags. The kraft bags were folded and stapled. Thirty-two uniform-size (2½- to 2¾-inch) potatoes were packaged in each bag to give a uniform amount of evaporating surface.

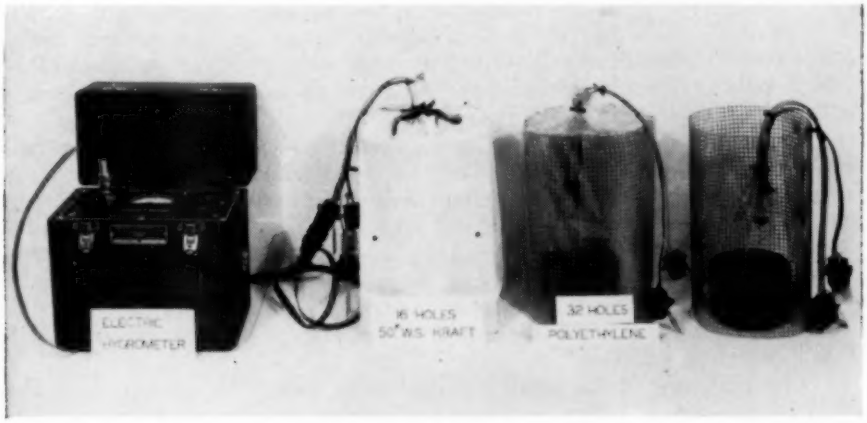


Figure 1.—Measuring the relative humidity in wet-strength kraft and perforated polyethylene bags containing a pan of water. At the right are wire screen for support, pan, and electric hygrometer sensing elements.

The polyethylene bags (200-gauge, 11 x 19 inches) were perforated with 8, 16, 32, 48, 64, and 80 ¼- or ⅛-inch holes; wet-strength kraft bags were perforated with 16 ¼-inch holes. Non-perforated bags of both of these materials were also included. One lot of polyethylene bags was perforated with 72 ⅛-inch U-shaped die-cut "Trap-door" flaps. Five duplicate bags with each type of perforation were used, but all types were not included in every test.

The packages of potatoes were laid flat in a single layer in a non-lighted 70° F. room with 50 per cent relative humidity for a 7- or a 10-day holding period. Weights were recorded at the same time each day. One lot of potatoes in polyethylene bags with 64 ¼-inch holes was

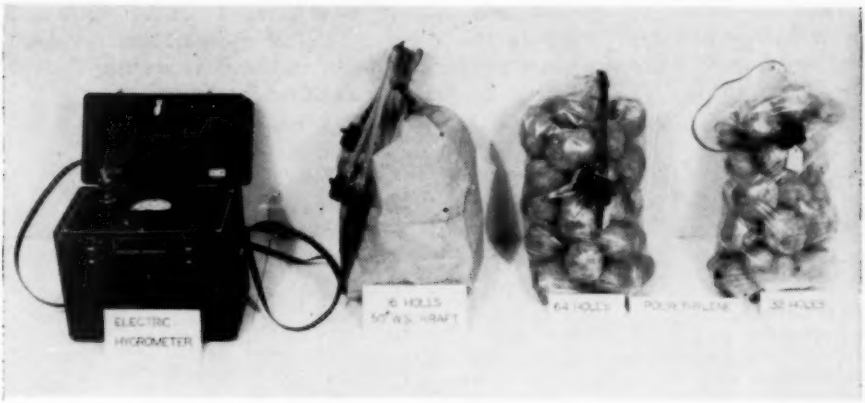


FIGURE 2.—Measuring the relative humidity in wet-strength kraft and perforated polyethylene bags containing potatoes.

held in large kraft shipping bags ("balers", 13 x 7 x 37 inches) to simulate holding retail stocks not on display. These shipping bags were made of 2 layers of 60-pound wet-strength kraft paper and with 24 ⅜-inch ventilation holes.

Relative humidity was measured with an American Instrument Co. electric hygrometer in one bag of each type, the sensing elements being inclosed in the center of each bag containing potatoes and 4 to 5 inches above the water in the bags containing only the water pans. Humidity readings were recorded 2 or 3 times daily and averaged for the 7- or 10-day holding period.

Results of Perforation and Relative Humidity Test

Increasing the number of ventilation holes in moisture-proof polyethylene bags from 0 to 80 lowered the internal relative humidity and increased the moisture vapor transmission rate as measured by the weight loss from a pan of water. A non-perforated polyethylene bag had an average relative humidity of 97 per cent during 7 days' storage at 70° F. while bags with 32 and 64 ¼-inch holes had relative humidities of 70 and 61 per cent, respectively (Table 1.) One-eighth-inch holes were nearly as effective as ¼-inch holes in lowering the relative humidity. Moisture losses per day were only slightly greater with the larger diameter perforations.

Seventy-two ⅛-inch U-shaped "Trap-door" flaps for ventilation of polyethylene bags were much less effective than open perforations for lowering relative humidity. These flaps in their normal position are largely closed and allow only slight diffusion of moisture vapor.

Non-perforated wet-strength kraft bags were very permeable to moisture vapor. The average relative humidity found in these bags was close to that of the storage room (50 to 52 per cent). Adding 16 ¼-inch perforations to kraft bags had little effect on the internal humidity.

Adding numerous cut-out perforations to polyethylene bags of potatoes effectively lowered the internal relative humidity. This was

TABLE 1.—*Effect of number and size of ventilation holes in 10-pound polyethylene and kraft bags on the average relative humidity in the bags and the loss of water from an evaporating pan in the bags during 7 days at 70° F. and 50 to 52 per cent relative humidity*[1].

Type of Bag	Number of Cut-out Holes per Bag	¼-inch Holes		⅛-inch Holes	
		Relative Humidity	Water Loss per Day	Relative Humidity	Water Loss per Day
		Per cent	Grams	Per cent	Grams
Polyethylene	0	97	1.0	97	1.0
Polyethylene	0[2]	—	—	94	2.0
Polyethylene	8	88	3.1	91	2.4
Polyethylene	16	83	4.3	85	4.1
Polyethylene	32	70	6.1	76	5.8
Polyethylene	64	61	7.9	64	6.9
Polyethylene	80	58	8.6	60	7.9
Kraft paper	0	53	9.1	—	—
Kraft paper	16	52	9.4	—	—

[1]Evaporating pan was 4½ inches in diameter and had 15.9 sq. in. of evaporating surface. There were no potatoes in these bags (Figure 1).
[2]These bags had no cut-out holes but were perforated with 72 ⅛-inch U-shaped die-cut "Trap-doors" for ventilation.

desirable for good keeping quality as evidenced by reduction or elimination of surface mold. The relative humidity in polyethylene bags of potatoes with no perforations or with flap-type perforations averaged 98 per cent or higher whereas 85 to 90 per cent humidity is recommended for potatoes. Condensation, or fogging, was extensive on the inside of these bags (Table 2). As a consequence of the high humidity a superficial surface mold grew on many of the potatoes. Development of bacterial soft rot and other decay was negligible in all bags regardless of the number of holes.

It should be pointed out that relative humidity in bags of potatoes was not static. It was very high in most bags soon after packaging and then gradually dropped during the 10-day holding period, depending on the number of ventilation holes. Relative humidities were higher in bags containing potatoes than in similar bags containing only a pan of water. Laying the bags of potatoes on their side blocked many of the perforations, and the potatoes blocked still others. The results with Sebago and Green Mountain varieties were similar.

Potatoes packaged in polyethylene when still damp had a slightly greater need for ventilation than potatoes packaged dry. Thirty-two or 48 ¼-inch holes in polyethylene bags were satisfactory for potatoes packaged dry, but 48 or 64 holes were more desirable than 32 for damp potatoes. Probably 48 holes is an adequate number for either damp or dry potatoes. This number of ¼-inch holes did not appear to weaken polyethylene bags. The keeping quality of potatoes packaged damp or dry was equally good if the polyethylene bags were adequately ventilated, and there was no marked difference in weight loss between the damp or dry potatoes.

TABLE 2.—*Effect of number of ¼-inch ventilation holes in 10-pound polyethylene and kraft bags of Sebago and Green Mountain potatoes on relative humidity and fogging in the bag and weight loss and surface mold of the potatoes after 10 days at 70° F. and 50 to 52 per cent relative humidity.*[1] *(Values for weight loss, surface mold, and fogging based on 5 duplicate bags)*

Potato Variety and Type of Bag	Number of ¼-inch Holes per Bag	Average Relative Humidity		Weight Loss		Surface Mold		Fogging	
		Dry Pack	Damp Pack	Dry Pack	Damp Pack	Dry Pack	Damp Pack	Dry Pack	Damp Pack
		Per cent	Per cent	Per cent	Per cent				
Sebago:									
Polyethylene	0[2]	99	—	0.6	0.7	Extensive	Extensive	Extensive	Extensive
Polyethylene	8	98	—	1.1	1.0	Extensive	Extensive	Extensive	Extensive
Polyethylene	32	95	—	2.5	2.2	Slight	Extensive	None	Slight
Polyethylene	48	92	—	3.6	2.9	None	Slight	None	None
Polyethylene	64	80	—	3.9	2.6	None	None	None	None
Polyethylene	80	69	—	3.8	2.1	None	None	None	None
Kraft paper	16	58	—	4.9	2.9	None	None	———	———
Polyethylene (in baler)[3]	64	97	—	2.2	1.9	Extensive	Extensive	None	Slight
Green Mountain:									
Polyethylene	0	99	99	0.1	0.2	Extensive	Extensive	Extensive	Extensive
Polyethylene	0[2]	98	99	0.5	0.6	Extensive	Extensive	Extensive	Extensive
Polyethylene	8	90	97	1.1	0.8	Extensive	Extensive	Extensive	Extensive
Polyethylene	32	86	80	1.5	1.5	None	Slight	None	Slight
Polyethylene	48	67	74	1.9	1.8	None	None	None	None
Polyethylene	64	67	61	1.8	1.8	None	None	None	None
Polyethylene	80	69	58	1.9	2.1	None	None	None	None
Kraft paper	16	67	56	2.5	2.3	None	None	None	None
Polyethylene (in baler)[3]	64	99	99	1.2	—	Extensive	Extensive	None	Slight

[1]Thirty-two uniform-size potatoes per bag (2½- to 2¾-inch size). Humidity was recorded 2 or 3 times daily and then averaged for the 10-day period. The Sebago potatoes were freshly harvested, while the Green Mountains had been in 40° F. storage for 2 weeks prior to this test.

[2]These bags had no circular ¼-inch holes but were perforated with 72 ⅛-inch U-shaped-die cuts, "Trap-doors."

[3]Bags same as others with 64 holes but all 5 bags were stored in a kraft shipping bag having 24 ⅜-inch holes.

Weight losses of potatoes in non-perforated polyethylene bags were less than 1 per cent after 10 days at 70° F., but the condition of the potatoes was poor. Weight losses generally become higher as the number of perforations in polyethylene bags was increased. However, even with 80 holes in these bags, weight losses were slightly less than in kraft bags.

An interesting comparison can be made between the weight loss from an evaporating pan of water and that from 10 pounds of potatoes in the same type bag. Although the potatoes provided approximately 40 times as much surface as the water, moisture losses from the potatoes averaged only twice as high. The potatoes blocked many of the ventilation holes and thus reduced weight loss; also, mature potatoes have a fairly good natural covering against moisture loss. Both Sebago and Green Mountain potatoes kept as well in polyethylene bags perforated with 48 or more holes as in kraft bags.

Potatoes in perforated polyethylene bags stored continuously in kraft shipping bags did not keep as well as if not stored in the shipping bags. The relative humidity within bags stored in shipping bags averaged 97 to 99 per cent. The bags of damp-pack potatoes were slightly fogged on examination and the potatoes in both packs had extensive surface mold. Apparently the close contact of the consumer units with each other blocked many of the perforations and kept them from functioning. It is apparent that polyethylene bags of potatoes, even though perforated, should not be stored in kraft shipping bags for longer than about a week at 70° F.

Experiment II (Test with 6 Types of Consumer Bags)

Description of Tests with 6 Types of Consumer Bags

The following types of 10-pound potato bags were compared as shown in figure 3.

1. Kraft paper, no perforations, double wall, wet-strength, 7¾ x 4¾ x 17 inches, stapled closure.
2. Kraft paper, 16 ¼-inch perforations, double wall, wet-strength, 7¾ x 4¾ x 17 inches, stapled closure.
3. Kraft paper with mesh window, double wall, wet-strength, 7¾ x 4¾ x 17 inches, window of ¼-inch paper mesh material, 3¼ x 7 inches, stapled closure.
4. Paper mesh, orange, approximately $^{5}/_{16}$-inch mesh, 12 x 19 inches, drawstring closure. These bags had a 5-inch wide paper band woven around the center for advertising purposes.
5. Polyethylene 250, elastic top, 48 ¼-inch perforations, 7 x 4 x 17 inches. These bags had a 2-inch diameter elastic top which could be stretched to 6 inches for filling.
6. Polyethylene 200, 48 ¼-inch perforations, 7¼ x 3¾ x 19 inches, closed with wire "Twist-ems."

Katahdin potatoes from Long Island, New York, were used in the first test during August and September 1952 and Green Mountain potatoes from Maine in the second during October and November 1952. The Katahdin potatoes were freshly harvested, with only slight skinning by U. S. Standards. The Green Mountain potatoes were stored after harvest for 1 month at 40° F. and 85 per cent relative humidity in 100-pound burlap bags before this test. Both varieties were washed and dried before

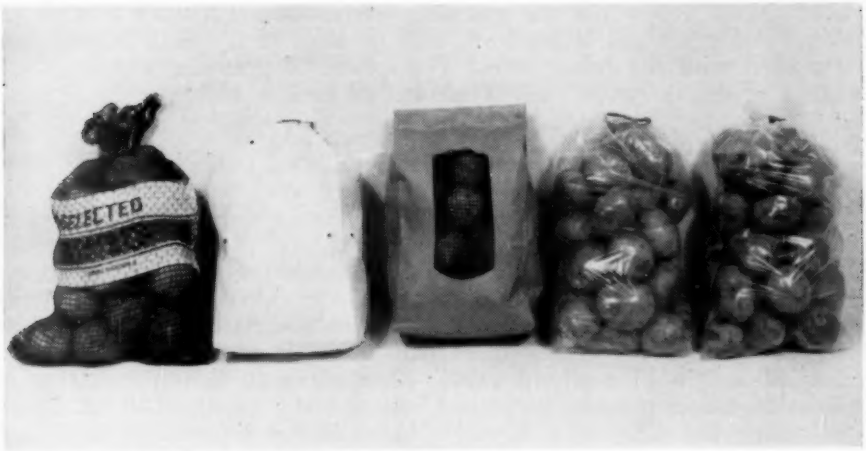


FIGURE 3.—Five of the six types of 10-pound bags tested for potatoes. Left to right: paper mesh with paper band around the center, perforated kraft, kraft with mesh window, elastic-top polyethylene, and tied-top polyethylene.

packaging. Potatoes with serious defects including those with sunburn were removed so that those used in the tests were approximately U. S. No. 1 grade. The Green Mountain potatoes showed 7 to 8 per cent mechanical damage on examination after washing. The Katahdin potatoes averaged smaller than the Green Mountain potatoes. The average numbers of potatoes in 144 ten-pound bags of each variety were 40 Katahdin and 35 Green Mountain potatoes.

Twenty-four bags of each type were packaged and one-half were placed in a 70° F. room with 50 to 52 per cent relative humidity; and one-half in a 40° room with 85 per cent relative humidity. One-half of the packages of potatoes stored at 70° and all those at 40° were in kraft master shipping bags. After storage for 0, 1, 2 or 4 weeks at 40° or 70°, 6 bags of each type were arranged in a single layer under incandescent lights in a 70° room with 50 to 52 per cent relative humidity to simulate retail store conditions. Three of these were opened and examined for greening and decay after 3 days and the remainder after 7 days. The lights were turned on 9 hours a day during this 7-day period. For the Katahdin potato test the light intensity on the bags was 10 to 20 foot-candles. It was increased to 30 to 60 foot-candles for the test with Green Mountain potatoes. Unpublished data of Schomer and Lewis (8) showed that the light intensity on potato displays in retail stores averaged 31 foot-candles and ranged from 7 to 59 foot-candles.

Greening caused by light was classified as moderate or severe. Since such greening of potatoes in storage or on retail display is not carefully defined in U. S. Standards, in contrast to sunburn injury, reference was made to Maerz and Paul's (6) color dictionary. The greening of the outer cortex tissue that was considered moderate matched colors 19-G-1 and 19-H-1; the deeper type of greening recorded as severe matched 19-K-1 and 19-K-2. This severe greening was sufficient to remove potatoes from

U. S. No. 1 grade. For the greening determinations a small area of the skin (periderm) was scraped off, and the color of the flesh beneath was compared with the color plates. The extent of greening was largely a matter of degree rather than of amount of surface affected.

Results of Tests with 6 Types of Consumer Bags

Losses of weight of potatoes in mesh bags, kraft bags with mesh windows, and perforated and non-perforated kraft bags were generally fairly similar. Actually, the highest weight losses were found most often in the mesh bags, but this was more apparent with newly-harvested Katahdin potatoes than with Green Mountain potatoes from storage (Tables 3 and 4). The lowest weight losses were from the 2 types of perforated polyethylene bags. Potatoes in the elastic-top polyethylene bags lost slightly more weight than those in tied-top polyethylene. Loss of weight of newly-harvested Katahdin was higher than that of Green Mountain potatoes which had been stored a month at 40° F. before packaging, and differences in weight losses in the different types of bags were much more apparent with the former. Packaged Katahdin potatoes held 4 weeks at 40° followed by a week at 70° lost 5.2 per cent in paper-

TABLE 3.—*Weight loss, greening, and decay of Katahdin potatoes in different types of 10-pound consumer bags stored in kraft shipping bags at 70° or at 40° F. followed by retail display for 3 and 7 days at 70° and 50 to 52 per cent relative humidity*[1]

(Lights on 9 hours daily while on display, 10 to 20 foot-candles.)

Storage period before retail display and type of bag	Number of 1/4-inch holes	Weight loss[2]		Greening				Decay[2]	
		3 days	7 days	3 days		7 days		3 days	7 days
				Severe	Total	Severe	Total		
		Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent
Not stored, displayed at 70° F.:									
Kraft paper	0	1.6	3.1	0.0	0.9	0.0	0.0	0.0	1.8
Kraft paper	16	1.1	2.3	0.0	0.8	0.0	0.8	0.8	0.0
Kraft with mesh window	-	2.0	3.3	0.0	0.9	0.0	8.6	0.0	0.0
Paper mesh with paper band	-	2.6	4.4	0.0	0.8	0.0	11.4	0.0	1.5
Polyethylene, elastic-top	48	1.3	1.7	0.0	0.9	0.0	23.7	0.0	0.0
Polyethylene, tied-top	48	1.0	2.0	0.0	1.6	0.0	15.3	0.0	0.0
Stored 1 week at 70° F. in shipping bag, then displayed at 70° F.:									
Kraft paper	0	2.9	3.8	0.0	0.0	0.0	0.0	0.0	1.7
Kraft paper	16	2.7	3.7	0.0	0.0	0.0	0.0	0.0	0.0
Kraft with mesh window	-	3.3	4.1	0.0	0.0	0.0	7.2	0.0	0.8
Paper mesh with paper band	-	3.7	4.7	0.0	0.8	0.0	13.2	0.0	0.8
Polyethylene, elastic-top	48	1.7	2.7	0.0	0.9	1.8	26.4	0.0	0.9
Polyethylene, tied-top	48	1.2	2.3	0.0	4.4	0.0	16.8	0.0	0.8
Stored 2 weeks at 40° in shipping bag, then displayed at 70° F.:									
Kraft paper	0	2.6	3.8	0.0	0.0	0.0	0.0	0.0	0.9
Kraft paper	16	2.6	3.9	0.0	0.0	0.0	0.0	1.8	2.4
Kraft with mesh window	-	2.6	3.9	0.0	0.0	0.0	14.7	0.9	1.0
Paper mesh with paper band	-	3.3	4.7	0.0	0.0	0.0	27.0	2.4	1.5
Polyethylene, elastic-top	48	1.3	2.8	0.0	5.6	0.0	53.7	1.6	0.0
Polyethylene, tied-top	48	1.1	2.2	0.0	1.7	0.0	56.0	0.0	1.6
Stored 4 weeks at 40° in shipping bag, then displayed at 70° F.:									
Kraft paper	0	3.2	4.2	0.0	0.0	0.0	0.0	2.8	2.4
Kraft paper	16	3.5	4.3	0.0	0.0	0.0	0.0	3.0	3.4
Kraft with mesh window	-	4.0	5.0	0.0	2.7	0.0	11.9	0.0	1.7
Paper mesh with paper band	-	4.5	5.2	0.0	1.6	0.0	25.6	2.3	2.6
Polyethylene, elastic-top	48	2.1	2.7	0.0	5.4	0.0	50.9	1.8	0.9
Polyethylene, tied-top	48	1.6	2.6	0.0	5.6	0.0	40.9	4.0	1.5
Average of 4 holding periods:									
Kraft paper	0	2.6	3.7	0.0	0.2	0.0	0.0	0.7	1.7
Kraft paper	16	2.5	3.5	0.0	0.2	0.0	0.2	1.4	1.5
Kraft with mesh window	-	3.0	4.1	0.0	0.9	0.0	10.6	0.2	0.9
Paper mesh with paper band	-	3.5	4.8	0.0	0.8	0.0	18.0	1.2	1.6
Polyethylene, elastic-top	48	1.6	2.5	0.0	3.2	0.4	38.9	0.9	0.5
Polyethylene, tied-top	48	1.2	2.3	0.0	3.1	0.0	32.2	1.0	1.0

1/ Each value is based on 3 duplicate bags. These Katahdin potatoes were freshly harvested.
2/ The weight loss and decay data include the loss during the storage period indicated in the first column as well as during 3 or 7 days on display.

TABLE 4.—*Weight loss, greening, and decay of Green Mountain potatoes in different types of 10-pound consumer bags stored in kraft shipping bags at 70° F. or at 40° F. followed by retail display for 3 and 7 days at 70° and 50 to 52 per cent relative humidity.*[1]

(Lights on 9 hours daily while on display, 30 to 60 foot-candles.)

Storage period before retail display and type of bag	Number of 1/4-inch holes	Weight loss 2/		Greening				Decay 2/	
		3 days	7 days	3 days		7 days		3 days	7 days
				Severe	Total	Severe	Total		
		Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent
Not stored, displayed at 70° F.:									
Kraft paper	0	1.1	1.7	0.0	1.0	0.0	0.0	3.8	9.7
Kraft paper	16	0.9	1.7	0.0	0.0	0.0	0.0	3.8	6.7
Kraft with mesh window	-	1.0	1.7	0.0	2.1	11.3	23.6	7.2	6.2
Paper mesh with paper band	-	1.1	1.8	1.0	13.4	22.9	54.2	6.7	7.3
Polyethylene, elastic-top	48	0.7	1.7	0.0	19.6	38.7	72.0	4.3	7.5
Polyethylene, tied-top	48	0.8	1.3	1.0	15.3	37.8	72.8	4.8	8.7
Stored 1 week at 70° F. in shipping bag, then displayed at 70° F.:									
Kraft paper	0	1.9	2.4	0.0	1.0	0.0	0.0	3.1	3.8
Kraft paper	16	2.1	2.6	0.0	0.0	0.0	0.0	3.0	8.3
Kraft with mesh window	-	2.0	2.5	0.0	1.0	3.9	15.7	6.7	4.9
Paper mesh with paper band	-	1.9	2.5	0.0	6.4	17.2	35.4	4.6	7.1
Polyethylene, elastic-top	48	1.5	2.2	0.0	16.1	21.3	50.0	7.1	6.5
Polyethylene, tied-top	48	1.7	1.9	2.9	14.4	18.9	39.7	5.8	7.5
Stored 2 weeks at 40° F. in shipping bag, then displayed at 70° F.:									
Kraft paper	0	1.4	2.2	0.0	0.0	0.0	0.0	5.8	2.9
Kraft paper	16	1.4	2.2	0.0	0.0	0.0	2.1	4.3	5.3
Kraft with mesh window	-	1.4	2.5	1.0	6.2	0.0	8.9	4.1	3.3
Paper mesh with paper band	-	1.5	2.3	0.0	12.2	10.7	34.0	3.5	4.9
Polyethylene, elastic-top	48	1.0	1.8	0.9	18.0	35.6	61.3	4.5	4.0
Polyethylene, tied-top	48	0.9	1.5	0.9	23.3	28.1	62.5	4.7	7.3
Stored 4 weeks at 40° F. in shipping bag, then displayed at 70° F.:									
Kraft paper	0	1.8	2.6	0.0	0.0	0.0	0.0	6.1	7.1
Kraft paper	16	1.7	2.4	0.0	1.0	0.0	2.0	8.7	1.0
Kraft with mesh window	-	1.8	2.6	0.0	1.0	3.0	12.1	9.0	8.1
Paper mesh with paper band	-	2.0	2.7	0.0	3.0	16.0	36.8	8.0	4.7
Polyethylene, elastic-top	48	1.3	2.1	0.0	6.7	23.4	50.5	7.7	8.4
Polyethylene, tied-top	48	1.0	1.6	0.0	10.8	27.7	46.8	3.2	7.5
Average of 4 holding periods:									
Kraft paper	0	1.5	2.2	0.0	0.5	0.0	0.0	4.7	5.9
Kraft paper	16	1.5	2.2	0.0	0.2	0.0	1.0	5.0	5.3
Kraft with mesh window	-	1.5	2.3	0.2	2.5	4.5	15.0	6.8	5.6
Paper mesh with paper band	-	1.6	2.3	0.2	6.7	16.7	40.1	5.7	6.0
Polyethylene, elastic-top	48	1.1	1.9	0.2	15.1	27.7	53.4	5.9	6.6
Polyethylene, tied-top	48	1.0	1.6	1.2	15.9	28.1	55.4	4.6	7.7

1/ Each value is based on 3 duplicate bags. These Green Mountain potatoes had been in 40° F. storage for one month prior to this test.

2/ The weight loss and decay data include the loss during the storage period indicated in the first column as well as during 3 or 7 days on display.

mesh bags and 2.6 per cent in tied-top perforated polyethylene bags (Table 3.) This difference might be of practical importance in determining overage necessary in packaging to allow for shrinkage.

The decay in Katahdin and Green Mountain potatoes was largely fusarium rot. It was very slight on Katahdin potatoes in all types of bags even during the longest holding period, 4 weeks in a shipping bag at 40° F. followed by a week at 70° F. Higher decay was recorded in most of the Green Mountain potatoes, but in general there was no consistent difference in amount in the different kinds of bags as shown in tables 3 and 4.

Greening of Katahdin potatoes was slight to none in all bags after 3 days on display with 9 hours' exposure daily to a light intensity of 10 to 20 foot-candles, as you will note in table 3. After 7 days, moderate greening was high in bags which allowed light to strike the potatoes, but severe greening was still negligible. The most greening occurred in polyethylene bags and the least in solid kraft bags. Mesh bags with the paper band around the center and kraft bags with mesh windows allowed an intermediate amount of greening. Greening was observed to develop first around the lenticels.

Greening was more extensive in the Green Mountain potatoes exposed to a light intensity of 30 to 60 foot-candles. However, it was not serious at the end of 3 days on display, as severe greening even in the 2 types of polyethylene bags averaged only 0.2 and 1.2 per cent as revealed in table 4. After 7 days, severe greening averaged 29.7 and 28.1 per cent in the polyethylene bags. The average severe greening in the other types of consumer bags for the same tests was 16.7 per cent in mesh bags, 4.5 per cent in kraft window bags, and none in perforated or non-perforated kraft bags.

The effect of moderate and severe post-harvest greening on the cooking quality of Green Mountain potatoes as rated by 10 judges is shown in table 5. There was no significant difference in the color or flavor of peeled boiled potatoes or of baked potatoes with moderate or severe greening or with no greening. However, severely greened potatoes boiled with the skins on were rated significantly poorer in color than potatoes with no greening. It is probable that significant differences in flavor would be detected if the greening had been as intense as is sometimes seen in retail stores.

TABLE 5.—*Effect of post-harvest greening on the cooking quality of boiled and baked Green Mountain potatoes.*

Amount of Greening	Quality Rating (0 to 100 Basis)[1]					
	Boiled, Peeled		Boiled, Non-peeled		Baked	
	Color	Flavor	Color	Flavor	Color	Flavor
None	80.6	78.9	78.9	82.2	85.0	85.9
Moderate	78.3	80.0	73.3	79.4	82.3	83.2
Severe	75.6	78.3	65.6	73.9	84.8	81.1
L.S.D. 5 per cent level	6.3	7.4	10.4	9.1	5.7	9.4

[1]Mean rating of 10 judges. A color or flavor rating below 70 was considered unsatisfactory. The greening was developed by 7 days' exposure (9 hours daily) to 30 to 60 foot-candles of artificial light at 70° F.

SUMMARY AND CONCLUSIONS

Increasing the number of cut-out perforations in polyethylene potato bags effectively lowered the internal relative humidity. This was desirable for good keeping of potatoes. The relative humidity in non-perforated polyethylene bags of potatoes averaged over 99 per cent and was undesirable because of moisture condensation and growth of surface mold.

Sebago and Green Mountain potatoes packaged damp had greater need for ventilation than those packaged dry. About 48 ¼-inch holes in 10-pound polyethylene bags appeared to supply adequate ventilation for potatoes packaged either damp or dry. Holes ⅛-inch in diameter were only slightly less effective than the same number of ¼-inch holes for lowering the humidity.

Flap-type perforations in polyethylene bags (72 ⅛-inch U-shaped die-cuts) did not adequately allow the escape of moisture vapor.

Potatoes in perforated polyethylene bags should not be stored in perforated kraft shipping bags for longer than about a week at 70° F. Many perforations in the consumer units are blocked under such conditions and the relative humidity becomes excessively high.

Six types of 10-pound bags were compared as consumer bags for Long Island Katahdin and Maine Green Mountain potatoes during a period in storage and on simulated retail display. The keeping qualities of potatoes were similar in all types of bags except for greening and slight differences in weight loss. Weight losses in polyethylene bags perforated with 48 ¼-inch holes were usually slightly less than in mesh or kraft potato bags.

Wet-strength kraft bags were very permeable to moisture vapor. While perforations in kraft bags were not necessary to permit escape of moisture they might be desirable to increase cooling rates.

Greening developed in proportion to the amount of visibility that a package provided, being highest in polyethylene bags, intermediate in kraft bags with mesh windows, and least in solid kraft paper bags.

When Green Mountain potatoes were exposed to light (30 to 60 foot-candles) for 9 hours a day greening in the bags which permitted visibility was not serious after 3 days at 70° F. Severe greening developed after 7 days' exposure to light and adversely affected the color rating of potatoes boiled without peeling.

Various consumer-size bags which provide visibility, including well-ventilated polyethylene bags, should be satisfactory for potatoes if retail display is limited to approximately 3 days, reserve stocks being held in the dark.

Literature Cited

1. Childress, R. L. 1950. Grade qualities of potatoes in retail stores. N. Y. (Cornell) Agr. Exp. Sta. A.E. 707, (120 Pp.)
2. DeLoach, D. B., and G. R. Sitton. 1941. Marketing Central Oregon and Klamath Basin late-crop potatoes. Oreg. Agr. Exp. Sta. Bull. 400, (36 Pp.)
3. Folsom, D. 1947. Permanence of greening of potato tubers. Amer. Potato Jour. 24: 336-340.
4. Larsen, E. C. 1949. Investigations on cause and prevention of greening in potato tubers. Idaho Agr. Exp. Sta. Res. Bull. 16, (32 Pp.)
5. Lutz, J. M., H. Findlen, and G. B. Ramsey. 1951. Quality of Red River Valley potatoes in various types of consumer packages. Amer. Potato Jour. 28: 589-602.
6. Maerz, A., and M. R. Paul. 1930. A dictionary of color. McGraw Hill Book Company, New York. (207 Pp.)
7. Merchant, C. H., and H. C. Woodward. 1949 Quality of potatoes in retail stores in Boston, Massachusetts and Maine markets. Maine Agr. Exp. Sta. Bull. 466. (62 Pp.)
8. Schomer, H. A., and W. E. Lewis. 1949. Unpublished data. U. S. Dept. Agr., Bureau of Plant Indus., Soils and Agr. Engin., Beltsville, Md.

RED LA SODA — A MUTATION OF LA SODA[1]

R. E. Webb[2] and Julian C. Miller[3]

Most of the potato growing areas of the South and early northern areas are in need of a potato variety which produces large yields of tubers with an attractive red skin for the new potato trade. This has been one of the principal objectives of the Louisiana potato breeding program. Miller (1) developed and released the LaSoda variety which has an attractive, though light red, skin that has largely replaced Triumph as the standard variety in Louisiana. LaSoda has proven widely adapted in the South as well as in most northern seed-producing areas, yet a variety with a deeper red colored tuber is very desirable.

For several years occasional mutations in skin color of tubers of LaSoda have been observed. These skin color changes were usually to a white skin with pink eyes or varying degrees of suffuse splotches of red color over a white skin. The writers have been constantly alert for a skin color change to a darker more intense red than that of the tubers of LaSoda or Triumph. While grading foundation seed of LaSoda in the spring of 1949, Charles S. Blackman, Clark, South Dakota, found a tuber of LaSoda that was divided longitudinally with the two halves being decidedly different in the intensity of the red color. One-half was of the normal red blush of tubers of LaSoda, whereas the other half was of a darker, more intense red blush. The tuber was sent to Baton Rouge for observation and increase.

The original tuber weighed about six ounces. No differences in size, number or depth of eyes could be found in the two halves of the tuber. The tuber was cut along the color line demarcation and each half was divided into two seed pieces and planted. Tubers developed by the normal colored seed pieces were identical in color as those produced by tubers of certified foundation LaSoda. Those tubers produced from plants of the intensely colored seed pieces were of a deep red blush. These darker colored tubers were treated with ethylene chlorohydrin and sent to South Dakota for increase.

Plant and tuber characteristics of Red LaSoda are identical with those of LaSoda, except for the more intensely colored tubers.

Description

Plants — Medium in size, spreading; stems medium, prominently angled; nodes slightly swollen, green; internodes green; wings prominent, slightly waved, green; stipules large, green, scantily pubescent; leaves long, broad, close, dark green; midribs green and scantily pubescent; primary leaflets ovate, medium, three-four pairs, mean length 3.36 inches, mean width 1.84 inches, index 55.7; petioles green; secondary leaflets many, between primary leaflets; tertiary leaflets many in three positions, on midrib between pairs of primary leaflets, at junction of midrib and

[1]Accepted for publication August 25, 1953.
In cooperation with the United States Department of Agriculture.
[2]Formerly Associate Horticulturist, Louisiana Agricultural Experiment Station.
[3]Head of Horticultural Research, Louisiana Agricultural Experiment Station, Baton Rouge 3, La.

petioles of primary leaflets and on primary leaflet petioles; inflorescence medium branched; leafy bracts few, small; peduncles medium long, large, intermittently winged, green, scantily pubescent; pedicels medium to long, green, scantily pubescent.

Flowers — Calyx lobe tips long, green, scantily pubescent; corolla large in size, lavender; anthers orange yellow; pollen scant; style slightly curved; stigma globose, multilobed, green.

Tubers — Mostly elliptical to slightly oblong, tapering slightly to apical end, mean length 3.62 inches, mean width 3.24 inches, mean thickness 2.38 inches, ratio of length to width 89.5, ratio of thickness to width 73.4; skin a bright deep red; eyes wide, medium in depth; eyebrows prominent, curved; flesh white; sprouts white; maturity medium.

Characteristics and Adaptation

Red LaSoda produces a strong sturdy sprout with a well developed root system. Sprout emergence is a few days later than Triumph and the initial growth rate is slower. This eliminates some of the dangers of frost and makes for quicker plant recovery from late frost injury. As the season progresses, the growth rate of Red LaSoda increases and plants reach full bloom under favorable conditions about the same time as Triumph. At this stage of growth, plants of Red LaSoda are equally as resistant to tip burn, wind, heat and drought damage as LaSoda and noticeably more resistant than Triumph. Tubers of Red LaSoda are more resistant to the development of enlarged lenticels under excessive moisture conditions than those of Triumph.

All tubers of Red LaSoda have been kept in isolation in South Dakota for rapid increase of seed tubers and observation with foundation seed of LaSoda. Since 1950 it was obvious that Red LaSoda would produce yields equivalent to those of LaSoda and much higher yields than those of foundation seed of Triumph in the seed producing areas of South Dakota. In the spring of 1953 one hundred pounds of Red LaSoda tubers were planted in replicated trials at 4 locations in Louisiana for comparison with LaSoda, Triumph and Kennebec. The results of those trials are presented in table 1. Red LaSoda outyielded LaSoda, though not significantly, at three locations, and significantly outyielded Triumph at all locations and Kennebec at two. The percentage of Number 1 tubers was equivalent to those of LaSoda which usually runs between 90-99 per cent in the spring crop.

Quality of tubers of Red LaSoda is very similar to that of LaSoda and Triumph. Table 2 shows specific gravities and total solids of tubers of 4 varieties grown in Louisiana and South Dakota during 1953 and 1952 respectively.

The tuber flesh of Red LaSoda remains white after boiling and is slightly waxy in texture which prevents sloughing. Also, the tubers made excellent mashed potatoes and french fries. Good chips have been produced in trials with Kennebec.

Pathological Characteristics

Red LaSoda is susceptible to viruses x, y, leaf roll and spindle tuber. Spraying with a fungicide is needed to control early and late blight.

TABLE 1.—*Yields of 4 potato varieties at 4 locations in 1953.*

Variety	Location			
	Diamond[1]	Baton Rouge[1]	Donaldsonville[1]	New Roads[2]
Red LaSoda	196.6	311.9	322.8	281.3
LaSoda	193.9	297.8	319.1	329.7
Triumph	144.8	251.5	154.3	232.9
Kennebec	146.6	223.4	326.1	281.3
LSD at 5 per cent	31.3	36.1	53.4	—
LSD at 1 per cent	42.7	48.7	72.9	—

Yields expressed in bushels of U.S. No. 1's per acre.
[1]Average of 5 replications; [2]Average of 2 replications.

TABLE 2.—*Specific gravities and total solids of 4 potato varieties.*

Variety	Location			
	Louisiana 1953		South Dakota 1952	
	Specific Gravities	Per cent Total Solids	Specific Gravities	Per cent Total Solids
Red LaSoda	1.063	16.2	1.101	24.2
LaSoda	1.064	16.3	1.097	23.3
Triumph	1.065	16.5	1.095	22.9
Kennebec	1.074	18.4	1.104	24.8

Samples comprised 24 tubers.

DISTRIBUTION

Tubers of Red LaSoda have been sent to Wisconsin, Nebraska and Colorado for increase in those states. About four acres of foundation seed are being grown in South Dakota. A few bags will be placed with individual farms for additional trials this year. In the fall of 1954 ample seed should be available for distribution to growers in carlot shipments.

SUMMARY

Red LaSoda produces a very attractively colored tuber and several growers are anxious to obtain seed tubers. It has proven its adaptability in the seed-producing areas of the North and also its superior yielding ability over Triumph in the southern potato-producing areas. The Red LaSoda variety will yield equally as well as LaSoda and the tubers do not require added coloring to make an attractive product. The quality of the tubers is equally as good as most potato varieties grown in the southern states.

The authors feel that this potato variety has a definite place in the potato trade. There is always a heavy market demand for attractive red-colored tubers from most of the potato-growing areas of the United States.

Literature Cited

1 Miller, Julian C. 1948. Three new potato varieties. Amer. Potato Jour. 25: 89-91.

SUNKEN SCALD SPOT FIELD INJURY EVIDENT IN STORED POTATOES[1]

T. M. Whiteman and J. M. Lutz[2]

Sunken scald spot injury of potatoes may be recognized by the brown patches of the skinned areas (2), which at times become sticky or slimy through the action of bacteria. This type of injury is sometimes referred to as wind injury since it is prevalent chiefly where drying winds prevail during harvest. The degree of injury in the field is influenced by the temperature, relative humidity, and velocity of the air at digging time. The use of potato harvesters and bulk trucks for hauling the crop has reduced the incidence of sunken scald spot, but it still occurs in the part of the crop that is picked up by hand and poured into the usual 8-oz. burlap picker bags. These bags are often allowed to stand in the field much too long (possibly for 12 hours) before being hauled to the storage house.

Although sunken scald spot is most common in early-crop potatoes, which are usually marketed soon after harvest, under certain conditions it is troublesome in the storage crop in which it may be followed by serious decay and loss in weight. Bargar and Morris (1) reported that only about one-fifth as much surface browning occurred on White Rose potatoes exposed to drying winds for 5 hours in canvas bags as on those held in burlap bags. In their study, surface browning was produced by conditions corresponding to those causing sunken scald spot but the injury, although similar to that of sunken scald spot, covered much larger areas on the tubers.

The tests reported here were made to determine the importance of the factors causing sunken scald spot and to find means of limiting its occurrence or severity. In these tests, which were somewhat similar to those of Barger and Morris, potatoes in canvas bags and in burlap bags of different-weight materials were exposed in the field for varying periods immediately after digging.

[1]Accepted for publication October 6, 1953.

[2]Associate Horticulturist and Principal Horticulturist respectively, United States Department of Agriculture, Bureau of Plant Industry, Soils, and Agricultural Engineering, Beltsville, Md.

Materials and Methods

Triumph potatoes grown in the Red River Valley potato-producing area near Grand Forks, North Dakota, were used in these tests, conducted in 1949 and 1950. They were picked up in rubber-covered wire baskets immediately after digging and transferred to the various types of bags. The check (non-exposed) potatoes were removed from the field immediately after bagging. The remaining bags of potatoes were left standing singly in the field during exposure. In 1950 the rate of evaporation of water from an atmometer was measured near the bagged potatoes during their exposure periods. After each of the exposure periods (½ to 5 hours), the potatoes in the various bags to be compared were transported in a closed panel truck to the storage at East Grand Forks, Minnesota. After grading, 1 bushel of U. S. No. 1 tubers per treatment was held at 50° to 55° F. in a burlap bag of 8-oz. material for about 3 weeks and then stored at a minimum temperature ranging from 36° to 40°.

When the stored potatoes were inspected in late March sunken-scald-spot injury was classified as follows: (a) slight injury, not serious enough to disqualify the tubers for U. S. No. 1; (b) moderate injury, serious enough to disqualify the tubers for U. S. No. 1 but not for U. S. No. 2; (c) severe injury, serious enough to disqualify the tubers for U. S. No. 2.

Comparisons were made between tubers exposed in the field for identical periods (mostly 1 to 4 hours) in 10-oz. canvas and 8-, 10-, and 12-oz. burlap bags. The weights of bag materials refer to ounces per square yard. Previously air penetration through the different bag materials was measured by means of a 10-inch centrifugal fan with an air velocity at the outlet of 2450 feet per minute. When the outlet was covered with a single thickness of 8- or 10 oz. burlap or 10 oz. canvas, the air velocity was reduced to 1750, 1550, and 225 feet per minute, respectively. It is evident that the canvas was very effective in reducing the rate of air movement and that the burlap bags were not. Even the 10-oz. burlap reduced the rate of air flow by only slightly more than one-third.

Results and Discussion

Since sunken scald spot of potatoes develops chiefly on skinned areas it is obvious that the primary factor responsible for its prevalence is the extent of skinning at digging time. Satisfactory healing of the skinned surfaces of potatoes occurs under high relative humidity conditions rather than under conditions causing too rapid, superficial drying. The skinned areas on potatoes exposed to wind of even moderate velocity in the field are likely to dry rather rapidly unless the relative humidity of the atmosphere is comparatively high or adequate protection from wind of too low relative humidity is provided.

Table 1 reveals that tubers exposed in burlap bags on September 17 for only 1 or 2 hours and on September 21 for 2 or 4 hours were rather severely injured by sunken scald spots. Many of these spots were followed by decay. No sunken scald spot or decay occurred in the bags of tubers not exposed (checks) or in those exposed for approximately 4 hours in canvas bags, as shown in figure 1. Loss of weight during storage in tubers exposed in 10-oz. burlap bags was greater than in those exposed in 10-oz. canvas bags. In potatoes exposed in burlap bags weight loss in storage was

TABLE 1.—*Weight loss, sunken scald spot, and decay of Triumph potatoes after storage for about 6 months following field exposure in 10-oz. burlap or canvas bags, 1949.*

Digging Date and Exposure Period	Atmospheric Conditions During Exposure in Field			Tuber Weight Loss		Slight Sunken Scald Spot		Moderate Sunken Scald Spot		Severe Sunken Scald Spot		Tuber Decay Following Sunken-Scald-Spot Injury	
	Air Temperature	Relative Humidity	Wind Velocity	Burlap Bags	Canvas Bags	Burlap Bags	Canvas Bags	Burlap Bags	Canvas Bags	Burlap Bags	Canvas Bags	Burlap Bags	Canvas Bags
	°F.	Per cent	M.p.h.	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent
Sept. 17:													
0 hour	—	—	—	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
½ hour	70	34	28	——	——	20.5	0.0	0.6	0.0	0.1	0.0	0.0	0.0
1 hour	—	—	—	——	——	42.8	0.0	8.8	0.0	6.4	0.0	16.9	0.0
2 hours	75	28	22	——	——	44.5	0.0	12.2	0.0	2.2	0.0	5.2	0.0
Sept. 21:													
0 hour	—	—	—	10.8	——	0.0	——	0.0	——	0.0	——	0.0	——
1 hour	64	30	28	9.7	8.3	7.4	0.0	1.0	0.0	0.3	0.0	0.7	0.0
2 hours	66	30	25	12.6	9.5	31.3	0.0	17.8	0.0	12.0	0.0	15.0	0.0
4 hours	65	26	28	14.5	9.2	23.6	0.0	10.6	0.0	4.3	0.0	44.7	0.0

[1]Obtained from records of nearby airport.

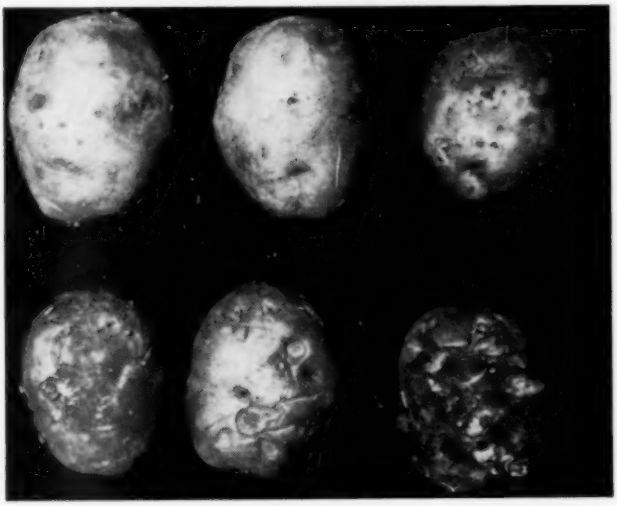


FIGURE 1.—Potatoes dug September 21, 1949 and photographed when removed from storage on April 5, 1950. Upper row: tubers exposed 4 hours in the field in a canvas bag and showing no sunken scald spots. Lower row: tubers exposed 4 hours in a burlap bag and showing severe sunken-scald-spot injury.

consistently greater but sunken-scald-spot injury, and resulting decay were not consistently greater as the exposure time in the field increased. However, most of the values were comparatively high for tubers exposed in burlap bags and appear to be due to the combination of rather high wind velocities, fairly high temperatures, and rather low relative humidities during the field exposures. Under the same field conditions the tubers in canvas bags apparently were adequately protected against too rapid drying of the skinned areas and did not develop any sunken scald spot or decay.

In table 2 the averages of the sunken-scald-spot values for the 1-, 2-, and 4-hour exposures for each digging show that the tubers exposed in burlap bags had about 2 to almost 20 times as much injury as those exposed in canvas bags. The grand-average values for potatoes in burlap bags, including all diggings, show that the most sunken-scald-spot injury occurred in tubers exposed in the 8-oz. bags and the least in those in the 12-oz. bags. Even the potatoes in the heaviest burlap bags (12-oz.) revealed nearly 4 times as much sunken-scald-spot injury as did those in the 10-oz. canvas bags. Under drying atmospheric conditions the close weave of canvas, by retarding wind penetration, also permits the relative humidity of the air within the bags of potatoes to increase, thereby creating an environment nearer the optimum for suberin formation. In the October 9 and 11 diggings sunken-scald-spot injury to potatoes in the various burlap bags increased as the exposure time in the field increased. A relatively small number of sunken scald spots occurred in the October 6 and 16 diggings. Weight loss in 1950 was not influenced by type of bag or length of exposure.

The evaporating power of the air as measured by an atmometer was applied to the data as a composite of the atmospheric factors (temperature,

relative humidity, and wind velocity). The data in table 2 show that when the atmometer readings were the lowest, the amount of sunken scald spot in general averaged the lowest in the potatoes exposed in burlap bags. In the October 9 and 11 diggings sunken scald spot in tubers exposed in burlap bags increased as water loss from the atmometer increased.

According to the data compiled in table 3, which are based on the use of an 8-oz. burlap bag of potatoes from each of 8 different diggings (including 4 reported in table 2) exposed 3, 4, or 5 hours, the tubers dug on October 9, 10, and 11 stand out as having excessive amounts of sunken scald spot after storage. The average air temperatures during the exposure periods on these days were about the same, but the wind velocity and relative humidity differed. The high wind velocity and low relative humidity on October 11 produced about twice the sunken-scald-spot injury to the tubers as either low wind velocity and low relative humidity on October 10 or fairly high wind velocity and moderately high relative humidity on October 9. Very few sunken scald spots were observed after storage in the tubers harvested September 29, October 5, or October 6. The last 2 days were characterized by conditions causing low evaporation from the atmometer.

Warm winds of high velocity and low relative humidity give conditions that are especially drying to any unprotected plant material of fairly high moisture content. These are the important factors that, in combination, cause sunken-scald-spot injury to skinned potatoes unless the tubers are adequately protected. Under these drying conditions picking up the potatoes into tight-weave bags, such as canvas, and hauling them to the storage house immediately after digging should reduce to a great extent the incidence and severity of sunken scald spot.

Summary and Conclusions

Freshly dug Triumph potatoes were exposed in burlap and canvas bags in the field for short periods (mostly not over 4 hours), stored in bushel lots in 8-oz. burlap bags, and inspected for loss in weight, sunken-scald-spot injury, and decay the following March.

The extent of sunken-scald-spot injury is influenced by the amount of tuber skinning. However, the degree of injury to the bagged potatoes was affected by the type of bag used, the length of exposure in the field, and the temperature, relative humidity, and velocity of the air during the exposure period.

There was little or no sunken-scald-spot injury after storage in potatoes not exposed in the field. Tubers exposed in the field in 10-oz. canvas bags showed much less sunken-scald-spot injury after storage than those exposed in 8-, 10-, or 12-oz. burlap bags. This was due, at least in part, to the reduced air penetration through canvas and presumably in part to a higher relative humidity of the air in the canvas bag as compared with that surrounding the potatoes in the burlap bag. Sunken-scald-spot injury to potatoes also decreased slightly as the weight of the burlap-bag material increased.

In 1949 loss in weight of potatoes during storage was slightly less in tubers exposed in the field in canvas than in burlap bags, but the following year this loss was about the same for all bag types.

TABLE 2.—*Weight loss, sunken scald spot, and decay[1] of Triumph potatoes after storage for approximately 6 months following field exposure in burlap and canvas bags, 1950.*

Digging Date and Exposure Period	Atmospheric Conditions During Exposure in Field[2]			Water Loss per Hour from Atmometer	Tuber Weight Loss When Exposure Was in Bags of Indicated Materials				Slight Sunken Scald Spot When Exposure Was in Bags of Indicated Materials[3]			
	Air Temperature	Relative Humidity	Wind Velocity		8-oz. Burlap	10-oz. Burlap	12-oz. Burlap	10-oz. Canvas	8-oz. Burlap	10-oz. Burlap	12-oz. Burlap	10-oz. Canvas
	°F.	Per cent	M.p.h.	Ml.	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent
Oct. 6:												
0 hour	49	82	18	—	5.6	—	—	—	2.1	—	—	—
1 hour	52	81	20	0.8	5.6	5.7	5.6	5.7	5.5	3.8	4.8	2.1
2 hours	53	83	28	0.9	5.5	4.8	5.9	4.4	3.3	1.5	3.1	2.4
4 hours	56	81	18	0.9	4.5	6.5	4.9	4.1	4.5	8.7	6.4	2.5
Average[4]	52	82	21	—	5.2	5.7	5.5	4.7	4.4	4.7	4.8	2.3
Oct. 9:												
0 hour	57	67	30	—	5.3	—	—	—	1.7	—	—	—
1 hour	61	58	27	2.7	4.7	4.3	6.0	5.2	8.3	2.2	4.4	3.7
2 hours	64	56	33	3.2	6.4	4.6	5.9	4.4	11.1	6.4	9.2	0.0
4 hours	67	55	23	3.7	5.1	5.1	5.2	5.5	25.6	38.9	20.4	4.8
Average[4]	62	59	28	—	5.4	4.7	5.7	5.0	15.0	15.8	11.3	2.8
Oct. 11:												
0 hour	60	40	38	—	4.6	—	—	—	1.8	—	—	—
1 hour	62	36	34	5.8	4.6	4.6	6.0	5.1	13.4	10.4	6.3	1.7
2 hours	64	36	36	6.5	5.9	4.7	6.5	5.6	50.7	24.5	23.1	4.6
4 hours	65	29	41	7.5	6.0	5.0	5.9	4.0	55.6	43.7	39.6	0.0
Average[4]	63	35	37	—	5.5	4.8	6.1	4.9	39.9	26.2	23.0	2.1
Oct. 16:												
0 hour	50	50	23	—	6.3	—	—	—	0.0	—	—	—
1 hour	52	43	18	3.3	6.7	6.3	7.7	5.2	12.7	10.8	14.1	0.0
2 hours	54	45	16	3.1	5.6	7.3	6.7	8.0	6.8	10.5	3.6	5.6
4 hours	56	42	12	3.4	6.7	—	—	5.5	9.0	15.7	3.6	6.3
Average[4]	53	45	17	—	6.3	6.8	7.2	6.2	9.5	12.3	7.1	4.0
Grand Average[5]	—	—	—	—	5.6	5.5	6.1	5.2	17.2	14.7	11.5	2.8

[1]Decay did not follow sunken-scald-spot injury except for small amounts in 3 cases after the October 11 exposure: 0.3 per cent after 2-hour exposure in 12-oz. burlap bag and after 4-hour exposure in 8-oz. burlap bag and 2.0 per cent after 4-hour exposure in 12-oz. burlap bag.

[2]Weather conditions noted during the exposure of potatoes in the field were: October 6, cloudy 3 hours, and light showers 1 hour; October 9, clear 3 hours; and partly cloudy 1 hour; October 11, clear 4 hours; October 16, clear 1 hour, and partly cloudy 3 hours. Tabular figures obtained from records of nearby airport.

[3]There was no severe sunken scald spot in 1950. Moderate sunken scald spot occurred only in the October 11 digging as follows: in the bags exposed for 2 hours there was 0.3 per cent in the 8-oz. bag, but none in the 10- or 12-oz. burlap or 10-oz. canvas bags; in those exposed 4 hours there were 2.9, 4.0, 2.1 and 0.0 per cent in the 8-, 10-, and 12-oz. burlap and 10-oz. canvas bags, respectively.

[4]Zero-hour values omitted except in averaging the factors under atmospheric conditions. The values for these averages are to the nearest whole number.

[5]Average of averages for each digging date with 0-hour values omitted.

TABLE 3.—*Weight loss, sunken scald spot, and decay[1] of Triumph potatoes after storage for approximately 6 months following field exposure in 8-oz. burlap bags, 1950.*

Digging Date	Exposure Period	Atmospheric Conditions During Exposure in Field[2]			Water Loss per Hour from Atmometer	Tuber Weight Loss	Slight Sunken Scald Spot[3]
		Average Air Temperature	Average Relative Humidity	Average Wind Velocity			
	Hours	°F.	Per cent	M.p.h.	Ml.	Per cent	
Sept. 29	4	53	53	10	—	7.7	1.6
Oct. 5	3	54[4]	75	12	1.0	6.2	1.0
Oct. 6	4	52	82	21	0.9	4.5	4.5
Oct. 9	4	62	59	28	3.7	5.1	25.6
Oct. 10	4	60	44	10	3.2	4.8	26.4
Oct. 11	4	63	35	37	7.5	6.0	55.6
Oct. 12	5	59	48	9	3.5	5.2	9.0
Oct. 16	4	53	45	17	3.4	6.7	9.0

[1]Decay did not follow sunken-scald-spot injury except in 1 instance: 0.3 per cent after the 4-hour exposure.

[2]Except where noted, averages from 3, 4, or 5 hourly readings were obtained from records of nearby airport.

[3]There was no severe sunken scald spot in 1950. Moderate sunken scald spot occurred only in the October 11 digging: 2.9 per cent in the tubers exposed 4 hours.

[4]Average of 2 hourly readings.

There was no decay present after storage in any potatoes exposed in the field in canvas bags, but in 1949 there was considerable decay in certain lots of those exposed in burlap bags.

LITERATURE CITED

1. Barger, W. R. and L. L. Morris 1943. Tighter picking sacks reduce surface browning of Early White Rose potatoes. U. S. Bur. of Plant Indus., Soils, and Agr. Engin. H. T. & S. Off. Rpt. 123, (3 Pp.) (Processed).
2. Werner, H. O. 1947. Commercial potato production in Nebraska. Nebr. Agr. Exp. Sta. Bull. 384, (173 Pp.) (See p. 106).

THE CYTOLOGY AND GENETICS OF THE POTATO *(SOLANUM TUBEROSUM)* AND RELATED SPECIES

M. S. Swaminathan and H. W. Howard

This article, published in 1953 in *Bibliographia Genetica*, volume 16, pages 1-192, is a comprehensive review of the literature on the cytology and genetics of potatoes for the years 1925 to 1952.

At the beginning of the article is an index of 7 pages. This is followed by an introductory section of 4 pages, which gives a brief review of the systematics of the tuber-bearing species of the genus *Solanum*. The second section covering 65 pages deals with cytology; the third section, dealing with genetics, involves 75 pages; the fourth section 12 pages in length discusses the origin of the first European potatoes, variations within potato varieties, bud mutations, chimeras, and related problems. Finally, there are 36 pages containing more than 750 references to the literature on the subject.

The reader is impressed by the progress that has been made during the last quarter of a century in the studies of the cytology and genetics of *Solanum tuberosum* and related species. He is impressed, further, by the apparent lack of agreement in many of the hypotheses presented. This is doubtless due to the numerous genotypes in the material resulting from heterozygosity, polyploidy, and aberrant chromosomal behavior. The book is an excellent reference and should be made available to every one interested in the subject.

It can be purchased from Martinus Nijhoff, Publisher, The Hague, for 18 guilders, which at the present rate of exchange is about $4.77.

F. J. Stevenson
Principal Geneticist, U.S.D.A.

THE POTATO ASSOCIATION OF AMERICA

COMMITTEES FOR 1954

OFFICERS AND EXECUTIVE COMMITTEE—

J. W. Scannell, *chairman*, Arthur Hawkins, J. C. Campbell, Wm. H. Martin, N. M. Marks, R. W. Hougas, Paul Eastman, C. W. Frutchey, J. H. Muncie.

STANDING COMMITTEES—

A. Program Committee—Officers of the Association, R. W. Hougas, *chairman*.

B. Nominating Committee—A. G. Tolaas, *chairman*; Ora Smith, Marx Koehnke.

C. Membership Committee—O. C. Turnquist, *chairman*; R. W. Hougas, J. C. Campbell, N. M. Parks, Marx Koehnke, Paul Eastman, C. W. Frutchey, F. E. Garrett.

Sub-committee on Sustaining Memberships—Arthur Hawkins, *chairman;* Julian Miller, Ora Smith, J. H. Muncie, A. E. Mercker, J. W. Scannell, G. H. Rieman, W. H. Martin, plus Membership Committee.

D. Auditing Committee—J. G. McLean, *chairman;* J. H. Schultz.

E. Committee on Local Arrangements—C. W. Frutchey, *chairman*; A. M. Binkley, C. W. McAnelly, L. A. Schaal, Marx Koehnke, George Stackywick.

SPECIAL COMMITTEES—

A. Policy Committee—C. W. Frutchey, *chairman*; Ora Smith, Marx Koehnke, Arthur Hawkins, O. C. Turnquist, N. M. Parks.

B. Honorary Life Membership Committee—J. H. Muncie, *chairman*; Executive Committee plus 10 Past Presidents.

C. Potato Introduction Committee—F. A. Krantz, *chairman*; F. D. Cochran, W. R. Mills, C. L. Vincent, R. W. Hougas, F. J. Stevenson.

D. Potato Certification Committee—H. M. Darling, *chairman;* E. L. Newdick, A. G. Tolaas, H. C. Moore, Marx Koehnke, R. C. Hastings.

E. Late Blight Investigations Committee—M. E. Gallegly, *chairman*; L. C. Peterson, Reiner Bonde, C. J. Eide, J. L. Howatt, W. R. Mills, R. V. Akeley, John Niederhauser.

F. Virus Disease Investigations Committee— W. G. Hoyman, *chairman;* Donald Folsom, E. S. Schultz, S. B. Locke, J. Munro, N. S. Wright, R. H. Larson.

THE POTATO ASSOCIATION OF AMERICA

FINANCIAL STATEMENT

For the year ending November 30, 1953

RECEIPTS

Bank balance on hand November 30, 1952	$ 907.44	
This includes $587.08 in Lelah Starks Fund		
Annual Dues (including $1600 from Sustaining Members)	6,350.72	
Sale of Advertising	2,087.91	
Sale of Reprints	2,026.11	
Sale of Indexes	111.00	
Miscellaneous, Back Numbers, etc.	431.47	
TOTAL RECEIPTS		$11,914.65

DISBURSEMENTS

Printing of Journal (12 issues)	$5,195.25	
Printing of Reprints	1,049.65	
Mailing and Supplies	595.06	
Editors Salaries (inc. balance of $300 from 1951)	740.00	
Treasurer's Salary (inc. bal. of $450 from 1951)	1,110.00	
Miscellaneous, A.I.B.S. Fee, Advertising, Meeting, etc.	270.21	
TOTAL DISBURSEMENTS		$ 8,960.17
BANK BALANCE on hand November 30, 1953		$ 2,954.48
This includes $542.08 in Lelah Starks Fund.		

LELAH STARKS FUND

On hand November 30, 1952	$ 587.08
Disbursements for reprints of special articles	45.00
On hand November 30, 1953	$ 542.08

EXACT WEIGHT Platform Scale Features Over-Under Indicator

. . . gives fast, visibly-accurate readings

This sturdy scale cuts seconds off each sacking or checkweighing operation. An adjustable damping mechanism speeds weighing — and magnified indication permits an accurate reading at a glance. Eliminates guess-work and over-weights. Reduces labor costs — increases profits.

Designed for predetermined weighing but is well adapted to general purpose use. Total indicator movement is approximately six inches, representing approximately seven pounds. Capacity 500 pounds. Write today for complete information on Model 4080.

There is no substitute for Exact Weight

Exact Weight Scales

Better quality control
Better cost control

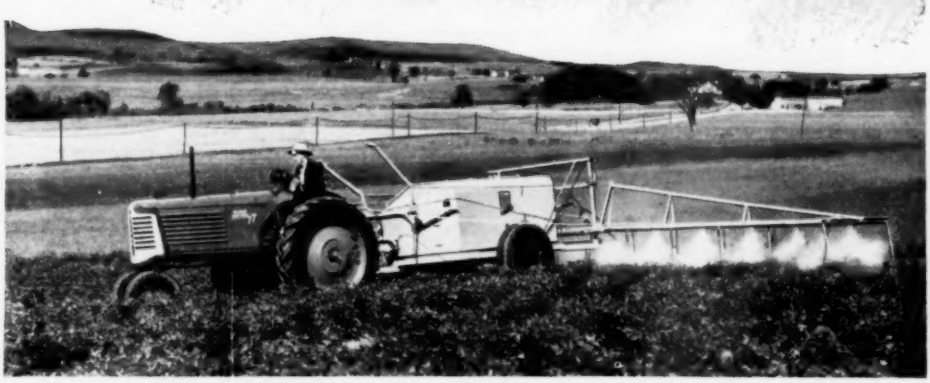
THE EXACT WEIGHT SCALE COMPANY

921 W. Fifth Avenue, Columbus 8, Ohio
2920 Bloor St. W., Toronto 18, Canada

University Microfilms
313 North 1st St
Ann Arbor Michigan

Protect Your Potato Crop

SPRAY THE IRON AGE WAY



Here's why you get more coverage at lower cost with IRON AGE

LISTEN to what potato growers say about spraying the Iron Age way: "I sprayed over 155 acres the full season without putting a wrench to my pump"... "Iron Age saves me money because I never have *any* pump trouble" . . . "Get better coverage with Iron Age than any other sprayer I've seen" . . . Iron Age performance pays off, because Iron Age builds sprayers in sizes and capacities to meet every potato grower's demand for a machine that delivers maximum coverage with low upkeep. The famous Iron Age pump maintains high pressures needed, and still takes a beating season after season without breakdowns. See your Oliver Iron Age Dealer about the model you need to insure top profits on your potato crop.

For complete information **write today to: THE OLIVER CORPORATION, Dept. 01, 400 W. Madison Street, Chicago 6, Illinois.**

OLIVER

IRON AGE

Finest in Farm Machinery

PLANT AND SPRAY... THE IRON AGE WAY